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IMPLEMENTATION OF INFORMATION TECHNOLOGY IN OFFICE SETTINGS: REVIEW OF RELEVANT LITERATURE

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I. INTRODUCTION

The primary aim of this literature review is to survey previous studies of the implementation of innovations in organizations in order to see what light they may shed on the introduction of computerized procedures into office settings. Specifically, such an undertaking should suggest hypotheses about classes of variables that are likely to affect short- and long-run outcomes of the implementation of information technology in work contexts, and should provide a framework for examining that process.

For this purpose office information technology is regarded as comprising multifunction computer systems that perform some of the information handling tasks of the work unit in interaction with their users; they encompass a number of autonomous parts whose tasks can be executed in parallel. This definition distinguishes the systems thought to typify the "office of the future" from closely related technologies that are single-function and/or noninteractive (e.g., voice message systems, typewriters with memories, computerized payroll processing, and other already widely diffused technologies).

While there exists a body of research related to technological innovation, there has been little systematic study of implementation of electronic information technology. Further, the bulk of extant research information on innovation represents the experience of public sector organizations, while the national productivity effects of office information technology are expected to stem largely from its use in the private sector. Consequently this review gives special attention to questions about the extent to which findings generated by studies of more limited types of innovation in public sector agencies can be expected to apply to the implementation of computerized information technology in private sector settings.

Scope and significance of the issue. Computer technology, having advanced tremendously since the introduction of magnetic card typewriters in the late 1960's, has already entered a substantial number and variety of private sector organizations. In 1978, for example, $750 million was spent on stand-alone word processing equipment, and such purchases are expected to increase by more than 250 percent in the next

three years (International Data Corporation, 1980). Of the estimated 3.5 million offices in the U.S., about 1.5 million are currently considered large enough for some form of electronic information system; and that figure can only increase as the production of minisystems permits smaller and smaller organizations to make efficient use of computers. The "office of the future" has thus been touted as the major change in work settings to be expected during the 1980's (cf. Coopers and Lybrand Newsletter, 1978; Mankin, 1978; Connell, 1979, 1980; Cockroft, 1979). At the National Bureau of Standards conference on distributed processing it was noted that "most large corporations and government agencies are planning or implementing 'office of the future' systems." Such changes are expected to affect well over 50 percent of the total work force (Bair, 1978). Moreover, the search for more rapid error-free communication as well as expanding needs to link information to large or remote databases and other equipment is creating a growing demand for local networks. A new eight-year forecast from International Resource Development, Inc. (1981) predicts local networks will represent a $3.2 billion market by 1990, even though only rudimentary short-range networks are presently available.

Expectations for implementation. The introduction of electronic information systems in varied user settings, then, constitutes a trend of long-term national significance. Recent literature yields a number of reasons for the rapid diffusion of these systems, reflecting primarily an intersection of economic needs and technological opportunities. Among the economic factors that constitute "the driving force behind the technological explosion to automate office operations" (Connell, 1979), personnel costs play a prominent role. Whether an organization is associated with a product or a service, "the office" is associated with information and communications; in particular, "office work" consists of "information-handling activities" such as reading and filing documents, performing computations, preparing reports, responding to requests, making decisions, and the like (Ellis and Nutt, 1980). These activities in traditional offices are highly labor-intensive (Strassman, 1980; Colton, 1979) and consequently relatively costly: The U.S. spends anywhere from $376 to $600 billion a year on salaries of

office-based people (Forest, 1979). But while employee costs have continued to increase, office productivity has not; rather, productivity improvements have lagged far behind industrial and manufacturing growth (Keating, 1980; Gehmlich, 1980; Young, 1980; Grove, 1979; Bennis, 1980). These problems are exacerbated by steady increases in amount of paper work required and the growing scarcity of paper, circumstances that increase labor time and work cost (Young, 1980; Whitney, 1980; Law and Pereira, 1976).

Concurrently, a variety of automated office systems have become readily available with computer costs decreasing. "Office automation has become increasingly cost-effective while office productivity has declined" (Magnus, 1980). "Automation," then, "seems to be the answer" (Forest, 1979; cf. Gottheimer, 1979). Thus, the vice president of international marketing requirements for IBM reports that "increasing productivity of both boss and secretary will be the focus of the office of the future" (Marketing News, 1979). Initially, computer technology was regarded as a means for achieving savings at the secretarial/clerical level. For instance, a 1974 article titled "We Need No Secretaries" (Shiff, 1974) argued that such systems could eliminate transcription, typing, and filing from office work; more modest proposals suggested that office technology could increase secretarial productivity by 25 to 33 percent (Law and Pereira, 1976). And on the public sector side, a 1979 General Accounting Office report noted that since nearly 12 percent of civilian white collar personnel are in secretarial jobs, "even slight increases in secretarial productivity would significantly lower the cost of this segment of the work force." The newest wave of automation affects highly skilled personnel as well. A survey made by Booz-Allen and Hamilton, in which almost 300 managers and professionals in 15 major U.S. corporations took part, concluded that from 15 to 30 percent of highly skilled office time is spent in information-handling tasks that could be computerized (Business Week, 1980; Hill, 1980; Patterson, 1980). A Dun's Review article suggests that such systems will in fact reduce the need for middle managers (Gottheimer, 1979). Finally, the recent proliferation of small computer systems is expected

to permit small as well as large organizations to increase their operational efficiency (Devore, 1979; Kling, 1980; McCormick, 1980).

The technological opportunity to address serious productivity and cost problems, then, emerges as the most visible issue for organizations in the introduction of computer systems into office settings. However, the literature also bears evidence of related but less well-defined social issues bearing on the office of the future. One such issue is the national importance of advanced capability for information organization and processing. While a number of the periodicals cited above called attention to increased "paper work," those increases are often interpreted generically as reflective of a transition into the postindustrial age of information (Mankin, 1978; Strassman, 1980). From that viewpoint, increasing the productivity of the office "becomes a major social challenge" as industrialized societies become service- and knowledge-based economies (Driscoll, 1979). From the same perspective, information becomes a "critical resource" whose effective management is an important component of "long-term U.S. performance" (Thoryn, 1980). Application of advanced technology to information-based work is seen in this light as linked to national progress and social benefits (Keating, 1980). Kling's (1980) recent social analysis of computing provides an extended theoretical and empirical account of this line of reasoning in his discussion of "systems rationalism."

A second major social issue arises in relation to the redesign of the office and the transformed nature of work necessitated by technological innovation. As one source put it, technological advance "will change the office as a place into the office as a system" (Sadler, 1980). While there is little disagreement over whether computerized procedures will change office settings and tasks, there is considerable dispute over just what sorts of changes to expect. Forecasts of the end of secretarial and middle management roles such as those cited above have generated varying responses. It is sometimes suggested that introduction of office technology will increase users' skill repertoires and will release time from repetitive and monotonous tasks for more autonomous and creative pursuits (e.g., Connell, 1979; Shiff, 1974; Hill, 1980).

Equally frequently it is argued that such procedures only deskill and fractionate jobs, replacing some workers and increasing the alienation of those who remain. Lower-level employees believe that new technology invariably routinizes work, creates more formalized structures, and leads to more authoritarian management styles (cf. National Association of Office Workers, 1980; Cockroft, 1979). Higher-level personnel are concerned that organizational changes may decrease their social power while technological changes result in the obsolescence of their skills (Frank, 1980; Kling, 1980). According to the Booz-Allen and Hamilton study (Modern Office and Data Management, 1980), administrative, managerial and professional level workers have been most resistant to technology. Kling's review of the social impacts of computing (1980) provides an extensive discussion of the relationship of office technology to social structures, behavioral roles and interaction patterns in the work setting. Potential impacts on communication and social relations in work settings are also reviewed by Ellis and Nutt (1980).

In sum, computerized office procedures constitute a technological innovation whose anticipated widespread introduction into the private sector has been linked with significant organizational and societal outcomes. As Kling (1980) underscores, these links have in the main been speculative but they are of considerable utility in pointing out areas of capability, potential benefit, and potential harm. It is instructive to review some experiences of private sector firms that have published reactions to or outcomes of attempts to automate, in order to see how they compare with prospective themes in the areas outlined above. It should be noted, however, that most such reports are not research-based but rather reflect highly selective views of individual managers, management consultants, or even systems vendors.

Recent implementation reports. A number of accounts present successful experiences. For example, an Administrative Management article (Hansen, 1977) reports surveying a number of companies that had installed word processing systems; all indicated "productivity gains and cost effectiveness" with the system (cf. also Lewis, 1979 and Modern Office Procedures, 1980 for similar outcomes). Another study

(Anderson, 1978) finds that computer-based message systems improve productivity by saving time, by increasing the volume of work performed, and by more efficient problem-solving. Specific positive accounts range from a pharmaceutical firm (Clutterbuck, 1978) whose office system had saved time at both the managerial and secretarial levels (increasing productivity at the latter level as well) to a life insurance firm (McCormick, 1980) whose introduction of minicomputers and distributed processing had cut proposal preparation time from days to half an hour.

For all such positive accounts, however, there are even more negative experiences on record. For example, a March 1980 Business Week article reports that "Many companies are having difficulties making word processing equipment work as planned"; expected productivity gains are believed to require more efforts at organizing the introduction of those systems and especially at overcoming both secretarial and managerial resistance. Similarly, a Management Focus article (Krasan, 1980) notes that the "magical machines" work as well as vendors say they do, but that most organizations nevertheless have not seen productivity improve "mainly because people in charge have not been laying the groundwork for office automation" (cf. McIntosh, 1980). Consequently, many of these machines are "sitting unused in some businesses" (Winkler, 1979) while "productivity is virtually static and the proportion of white-collar workers is following Parkinson's laws" (Lester, 1978). Finally, at a meeting focussed on office systems and information technology, the Administrative Management Society concluded that technological change in this area should slow down "with more emphasis on equipment evaluation based on human resources considerations" (Dickey, 1979).

While inferences drawn from such an unsystematic information base are necessarily tentative, it is fairly clear that although the expected proliferation of office systems is well under way, anticipations of economic gains have not been commensurately fulfilled. Initially promising outcomes appear to have given way to mixed effects or to outright disappointments. That is, office technology seems to exemplify Green's (1973) more general thesis that technology assessment, "especially in the early stage, likely will show an overweighting of benefits and an underweighting of risks."

With respect to computerized office procedures in particular, a variety of reasons for the discrepancy are suggested by the literature reviewed. A great majority of them can be understood in terms of the classes of factors (i.e., systems, organizational, and implementation variables) identified in recent research as major influences on the outcomes of innovation (cf. Bikson, 1980; Yin, 1978; Yin et al., 1976; Berman and McLaughlin, 1975, 1974; Pressman and Wildavsky, 1973). Perhaps the most common explanations cite planning failures, ranging from lack of recognition that introduction of computers would require thoughtful adaptation to lack of strategies for overcoming employee resistance to change in both higher- and lower-status positions. It is likely that recognition of a technological opportunity to improve productivity and efficiency was the dominant adoption impetus, and that little attention was given to implementation processes. However, as an NSF report (1973) on science, technology, and innovation concludes, the benefits of technology confluence should not be left to chance but should be promoted through careful research. Since alternative choices in the management of that process can apparently have substantially different economic and social impacts, it is appropriate and timely to give careful consideration to what can be learned from past research about potential influences on the outcomes of attempts to implement computerized information technology.

II. CONCEPTUAL FRAMEWORK

A framework for conceptualizing potential sources of influence on implementation of computerized procedures in office settings can be drawn from theoretical structures developed in a range of recent studies of the innovation process (see, for example, Tornatzky et al., 1980; Stevens and Tornatzky, 1980; Rice and Rogers, 1980; Eveland and Rogers, 1980; Eveland, 1979; Yin, 1978; Yin et al., 1976; Fullan and Pomfret, 1977; von Hippel, 1976; Berman and McLaughlin, 1975, 1974; Pressman and Wildavsky, 1973; and reviews in Bikson, 1980; of and HIRI/NIMH, 1976). The overview generated on the basis of these studies will be supplemented where possible by more specific research into implementation of information systems in work settings (see Keen, 1981; Gruenberger, 1981; Kling, 1980, 1978; Ellis and Nutt, 1980;

Danziger and Dutton, 1977). After discussing generic approaches, the review will provide greater detail about post-adoption implementation processes and then note particular issues that arise when this framework is brought to bear on understanding the incorporation of information technology in private sector work contexts.

Generic approaches. Current conceptions of innovation begin with the view that traditional approaches to describing and studying that process have been ineffective in a number of ways (Yin et al., 1976). Traditional approaches can for convenience be characterized as ranging along a continuum from idea- or expert-oriented to user- or consumer-oriented (Lingwood and Havelock, 1977). Earlier studies of innovation approached knowledge utilization "from the developer's side of the fence" (Perrin and Johnson, 1972), probably because that pole of the continuum was emphasized in the historically influential research and development model. The "R&D" model posits an explicitly rational sequence leading from scientific inquiry to the adoption and employment of innovative results. It supposes that a high cost of initial research and development that generates new ideas will be justified by the quantity and quality of long-range social benefits as the knowledge diffuses. Potential adopters are regarded as relatively passive consumers who will, when the results are disseminated, accept and apply them to meet their needs (Havelock, 1968b, 1969; Berman and McLaughlin, 1974; Guba and Brickell, 1974; HIRI/NIMH, 1976; Bikson, 1980). A substantial proportion of federal spending for research and development was guided by the notion that a "good idea," i.e., an innovation scientifically generated and supported by empirical study, would as a matter of course be widely utilized once it became known.

From this perspective, it was most reasonable to look to characteristics of innovations themselves to determine what factors might promote or impede successful adoption. The extensive review by HIRI/NIMH makes it evident that, in spite of differences in terminology, grouping and weighting, there has been considerable agreement regarding characteristics of innovations that affect their utilization. The most important and consensual factors (cf. Rogers, 1962, 1967; Rogers and Shoemaker,

1971; Glaser, 1973; Glaser and Ross, 1971; Glaser and Wrenn, 1966; Davis, 1971; Gordon et al., 1974; Yin et al., 1976; Bikson, 1980; and the work of Havelock and his colleagues) seem to be the following:

- <u>Advantage</u>: Accepting the innovation yields some advantage to the potential user and stands as an improvement over the present situation (economic and social benefits are both traditionally included).
- <u>Capability</u>: The proposed innovation is within the potential user's fiscal, manpower and physical limits; the user can "afford" it in terms of initial and continuing costs.
- <u>Comprehensibility</u>: The innovative system or device is easy to understand, learn, and use.
- <u>Divisibility</u>: The innovative system or device can be introduced in stages, in parts, or sequentially; it does not require a large-scale change all at once or across all tasks and modalities.
- <u>Testability/Reversibility</u>: It should be possible to test the innovation on a limited basis, to use it experimentally or provisionally, and reverse decisions when the new system or device shows need for improvement.
- <u>Credibility</u>: The innovation is espoused by eminent, authoritative and respected individuals or groups.
- <u>Compatibility</u>: The innovation is compatible with users' established practices, norms and values.

While it is clear that the characteristics of an innovation necessarily have a bearing on the success with which it can be introduced into user settings, research relying on the R&D model has not been able to explain at the level of the organization why some innovations succeed and others fail (Yin et al., 1976; Bikson, 1980). The difficulty arises because that model assumes, first, the simple transferability of innovative systems or devices from one context to another and, second, a passive role by adopters or users, all of whom are supposed to have the same action rationale (Yin et al., 1976; Berman

and McLaughlin, 1974; Groot, 1971; Bikson, 1980). Consequently, the later "social interaction" or "problem-solver" approach to innovation emphasized the user role in developing an account of innovative processes.

The problem-solving model assumes that users' needs are the starting point rather than the destination of innovation. More specifically, innovation is interpreted as part of a problem-solving activity among potential users that progresses from experienced and diagnosed needs, through information search and decisionmaking, to trial and evaluation of the preferred system or device (Yin et al., 1976; Rogers and Shoemaker, 1971; Lavin, 1972; Guba and Bickell, 1974; Havelock, 1974, 1969a; Lingwood and Havelock, 1977; Bikson, 1980). Successfulness of the change is evaluated by the extent to which it has met the original objectives while allowing the organization to achieve a new level of stability.

While this approach is not incompatible with an R&D explanation, it looks to users for the characteristics to be most heavily weighted in accounting for innovative accomplishments. Initial research based on the problem-solving model tended to think of users as individuals, investigating demographic and psychosocial variables predictive of innovation (Bikson, 1980). More recent studies--those of relevance here--have focused on characteristics of organizations that promote or impede innovation. As Yin et al. (1976) point out in some detail, these characteristics are readily conceptualized but operationalized only with considerable difficulty; moreover, the approach is still "preparadigmatic" and there are a great variety of organizational variables of possible significance. Consequently, there has been less consensus regarding influential characteristics of the innovating organization. Most sources, however, have included the following categories of organizational variables as likely to affect outcomes (Yin et al., 1976; Bikson, 1980; HIRI/NIMH, 1976; Berman and McLaughlin, 1975; Berryman, Bikson and Bazemore, 1978; Gordon et al., 1974; Rogers, 1972; Rogers and Svenning, 1969):

- Environmental factors: The broader environment in which the organization is embedded is seen as supportive of innovation to the extent that it is large and urbanized, richly technological, and economically vital.
- Organizational status: As a counterpart of the proinnovative environment, an organization is seen as more likely to be innovative in relation to its size and vitality, the composition of its staff (e.g., proportion of professionals, extent of unionization), and its prior history of or level of support for innovation. Size effects, however, are not always consistent.
- Organizational structure: Among the many structural variables addressed, the most common represent centralization or decentralization of decision-making, degree of hierarchization, and extent of formalization of roles and tasks. Contrary effects have been found for degree of centralization.
- Work design: Included among work design variables related to innovation are diversity or specialization of activity, interdependence of work groups, and openness of communication horizontally and vertically.

The problem-solving approach, by adding organizational factors to the set of predictor variables, provided an improved foundation for understanding successes and failures in attempts to innovate. However, like the R&D approach, it stresses the concept of adoption of an innovation, underestimating the role of implementation factors in explaining the outcomes of that process (Bikson, 1980; Yin et al., 1976). Research directed toward implementation originated in a recognition of serious inadequacies in any approach that focuses on conditions for initiating change and not on later stages of change (Yin, 1978; Yin et al., 1976).

Shortcomings of "adoption" oriented innovation research are both theoretical and empirical. Conceptual difficulties, critically reviewed by Eveland (1979), include the unspecifiability of an adoption point

in the innovation process, the implicit assumption that what is adopted has a univocal meaning (assertible in advance and visible in practice), and consequent problems in its unambiguous measurement across inovation contexts as a dichotomous outcome variable. Empirical difficulties with the adoption framework, however that construct might be defined for innovation research purposes, are also numerous: For instance, it leaves out of account the most lengthy and demanding part of the innovation process--implementation (cf. Stevens and Tornatzky, 1980); during that process the nominal subject of study, i.e., what was adopted, is likely to change a great deal (e.g., Rice and Rogers, 1980); further, the results of innovation depend very substantially on characteristics of the implementation effort per se (e.g., Fullan and Pomfret, 1977); finally, for interpretation of outcomes of innovation attempts it is critical to know just what was in fact implemented (cf. Boruch and Gomez, 1977), and to what extent (e.g., Barker, Bikson and Kimbrough, 1981). Attention to these issues, together with an emphasis on the user perspective in studies of innovation (Jolly et al., 1978), has produced considerable research interest in implementation processes.

The major conclusion from research growing out of the implementation approach is that, instead of examining only features of the innovation and long-term characteristics of organizations that adopt them, explanations of successful and unsuccessful technology transfer should turn mainly on the operation of strictly situational characteristics surrounding the introduction and use of such systems in particular organizational contexts (Bardach, 1980; Eveland and Rogers, 1980; Tornatzky et al., 1980; Yin, 1978, Yin et al., 1976; Berman and McLaughlin, 1978, 1976, 1975, 1974; Spak and Shelly, 1978; Jolly, Creighton and George, 1978; Fullan and Pomfret, 1977; Guba and Brickell, 1974; Pressman and Wildavsky, 1973; NSF, 1973; Creighton, Jolly and Denning, 1972). Among the variables generated for investigation by the implementation approach, those consensually found to be most important for explaining the change process and its outcomes can be grouped and described as follows.

- Reason for adoption: While a variety of incentives may be at work, the recognition of a need for a particular innovation is consistently linked to successful implementation.
- Key actors, critical mass: The support of higher-level personnel ("gatekeepers" for ideas in an organization) as well as the presence of a technology "entrepreneur" (an individual who champions and guides a scientific or technical activity) is relevant to successful implementation. In addition, the extent of distribution of the innovation through the organization bears on the development of new practices, norms and social roles as well as peer morale.
- Adaptive planning: Perhaps the most important construct in the implementation literature, adaptive planning refers to planning that occurs continuously and flexibly before and throughout the implementation period. It assumes that new systems and old organizations will both have to be adapted to suit one another (i.e., while the organizational context undergoes changes to accommodate the innovation, its features will have to be modified to meet local needs and requirements).
- User participation: User participation in implementation planning and decisionmaking is frequently associated with more positive outcomes for the innovation process.
- Training: A variety of training variables have been shown to influence outcomes. Most effective training is keyed to the specific organizational context and is tied to day-to-day operational needs. Local development of training materials as well as location, scheduling, and methods can be influential.
- Incentives: Outcomes can be better predicted if it is clear what are the incentives and counterincentives to change for the individuals and for the organization. In general, innovation is resisted to the extent that it requires changes not only in skills but also in behaviors, attitudes, social roles and social context, unless there are offsetting benefits.

While sources differ regarding relative strength (but not direction) of effect, such implementation factors have been found to account for more variation in outcomes than either innovation or organizational characteristics. Moreover it should be emphasized that alternative choices during the implementation period appear to affect not only short run outcomes of the innovative process but long-term costs and benefits as well (e.g., Danziger and Dutton, 1977; Yin et al., 1976; Berman and McLaughlin, 1975, 1976, 1978; NSF, 1973).

Post-adoption implementation processes. The implementation approach, by emphasizing post-adoption processes in innovating organizations, stimulated the development of constructs for their delimitation and measurement. Unlike "adoption," typically construed as a discrete event, "implementation" is viewed as a process bounded by adoption at one end and the achievement of a "relatively fixed set of operating routines" (Bardach, 1980) at the other. While conceptual difficulties attended the attempt to specify a precise point of adoption (see above), operationalizing that boundary proved relatively unproblematic. At least for technological innovations, implementation studies take as the initial event of interest an organization's "first use of a new device" (Yin, 1978; cf. Danziger and Dutton, 1977; Yin et al., 1976; Radnor et al., 1970; Havelock, 1969). Operationalizing the other boundary and chunking the intervening process, however, are more complex undertakings involving notions of time as well as degree and fidelity of implementation.

Time is a necessary condition for implementation, as is evident by references to it in terms of "process," "early" and "late" stages, "passages," "delays," and the like (e.g., Eveland, 1979; Eveland and Rogers, 1980; Yin, 1978; Bardach, 1977). But while temporal span is required, time is not a sufficient condition for implementation. Sheer duration of an innovation in an organization is not associated with extent of implementation and cannot be used to define the term of that process. Bardach (1977, 1980) for instance, demonstrates with a number of compelling examples that "time since adoption" may be as readily indicative of delay as of progress. Similarly, Keen (1981) provides an account

of "social inertia" in relation to the implementation of automated information systems in particular. Further, in their study of one technological innovation--computer-based geocoding--Eveland and Rogers (1980) found that 35 of 53 applications had reached the relatively late stage of implementation they term "interconnection." The time required ranged from 6 months to 10 years, and included instances of delays of up to 6 years; different steps in the implementation process occupied differing time spans. Focusing on late state implementation characteristics, Yin's (1978) investigation of five types of technological innovation yielded similar temporal variation and showed age to bear no statistically significant relationship to degree of incorporation. However, results showed a slight tendency for younger innovations to be better routinized.

On the other hand, temporal properties of implementation cannot be ignored in favor of a boundary definition that turns strictly on "routinization" or "incorporation" of innovation-relevant behaviors, since some attempts at innovation never reach that end while others attain it primarily by circumventing intended changes. Additionally, criteria are needed for knowing when and how to look for effects. Such considerations have given rise to more intensive examinations of the change process itself, in order to provide markers or stepwise indicators of progress toward implementation. That is, while it is generally assumed that time-since-first-use of a technological innovation will not be a consistent predictor of implementation, it is nevertheless likely that there are broad-based sequential stages roughly following one another in time. For example, Berman and McLaughlin (1974) chunk that process into three large-scale stages called "adoption," "implementation," and "incorporation" while Yin (1978) categorizes innovations as "marginally," "moderately," and "highly" routinized. Full incorporation, routinization, or whatever the end boundary of implementation is called, is treated as an ideal limit successively approximated in the change process. What is changing is assumed to be both the organization (as behaviors and structures are altered to meet requirements of the new sociotechnical

system) and the innovation (as it is modified to suit the embedding context). Recent implementation research has analyzed change processes from both perspectives, drawing attention to questions of both degree of implementation (extent of use of the innovative system) and fidelity of implementation (extent to which the innovation is deployed to meet original objectives). These questions are discussed in order below.

As Eveland and Rogers (1980) make clear, the process of installing an innovation in an organization is often not analyzed beyond the division into early and late stages (e.g., Berman and McLaughlin, 1974, 1975). Their own descriptive model provides five sequential stages of specification for calibrating degree of implementation, suggesting that it can be measured by degree of definition of the innovation (where both its meaning and its use are seen as acquiring shared, well-bounded interpretations). Implementation research as described here concerns the later, more action-centered, stages of "structuring" and "interconnecting" (Eveland and Rogers, 1980), whereby an innovative system becomes established within the structure and procedures of the work unit and the larger organization. In order to mark extent of implementation even more precisely, Yin (1978) has developed a passages-and-cycles measure of the routinization status of an innovation (see Yin, 1978 for an explanation of these constructs and Yin et al., 1978 for their operationalization). Briefly, a post-adoption organizational unit receives a score from 0 to 10 depending on how many of 10 specified institutional passages or cycles its innovative system has accomplished (accomplishment is treated dichotomously). Items comprising the measure include the following.

ROUTINIZATION STATUS MEASURE

EXPANSION

1. Equipment turnover or updating
2. Budget status (special versus line item)
3. Establishment of appropriate organizational status
4. Establishment of stable arrangement for supply and maintenance
5. Establishment of personnel classifications or certifications

DISAPPEARANCE

6. Changes in organizational procedures
7. Internalization of training program
8. Promotion of personnel acquainted with the innovation
9. Turnover in key personnel
10. Attainment of widespread use

In this analytic framework for viewing degree of implementation, events that occur only once are regarded as passages (e.g., the transition from special status to line item in a budget) while those that occur regularly (e.g., equipment turnover) are conceived as cycles. The first five items (collectively indicative of the "expansion" stage) roughly represent earlier steps in the implementation process while the last five (termed "disappearance") mark the transition of the formerly new system to a status in which it is no longer visible as an innovation but rather has become a routine part of the organization.

Besides questions of extent, questions of variability in the innovative system have been addressed to the implementation process. Clearly, innovations change in the transition to incorporation. The issue, in Elmore's (1979) terms, is how to distinguish "legitimate variations" from "outright failures of implementation." Moreover, the issue is complicated by considering different types or genres of variability during implementation. Eveland (1979), for instance, stresses the concept of variability in respect to the innovation as tool and also in respect to the innovation as use. Rice and Rogers (1980), on the other hand, offer a threefold typology for "reinvention" of innovations in the implementation process: technical; operations, services; management, organizational. And Fullan and Pomfret (1977) have proposed a five-dimensional schema comprising changes in materials, structure, roles/behaviors, knowledge/understanding, and values. Under whatever aspect variability is viewed, however, two sorts of responses have typically been made. The "fidelity approach" assesses implementation by means of the extent to which the actual result corresponds to the original or planned or intended result of the process (Fullan and Pomfret, 1977); for such an assessment, the "crucial parameters" of an

innovation must be specifiable in advance (Tornatzky et al., 1980). In contrast, the "mutual adaptation approach" explores change processes to see how innovations and their settings are modified during implementation (Fullan and Pomfret, 1977); it supposes that organizations often do not have a "specific blueprint" for innovation and that "reinvention is not necessarily bad" (Rice and Rogers, 1980).

Determining an appropriate response to the variability question probably depends at least in part on the nature of the innovation being implemented and the types of variation anticipated. Eveland's (1979) distinction between the innovation construed as tool and as use provides a conveniently generic basis for comparing types of innovative system change proposed in recent literature as they apply to the case of office information systems. In the diagram below, descriptions in the left-hand column apply to computerized office information systems as tools while those in the right-hand columns apply to such systems in use.

COMPARISON OF CHANGE AREAS FOR INNOVATIONS
DURING THE IMPLEMENTATION PROCESS

Eveland (1979):	Tool	Use	
Rice and Rogers (1980):	Technical	Operation/Service	Management/Organizational
Fullan and Pomfret (1977):	Materials	Knowledge/Understanding Behaviors/Roles	Structure Values Internalization
Computerized office information systems:	Hardware, Software	Methods of information handling employed by unit members about the new work flow technology	Organizational characteristics, attitudes

Computer-based office information systems are an instance of "task-diverse" (Yin, 1978) innovations involving a multiplicity of components in a "loose bundle" (Rice and Rogers, 1980; cf. De Sousa, 1981). Thus they are susceptible to substantial variability although it is likely that, once installed, they will exhibit greater variation qua use than qua tool. That is, hardware and software modifications are probably less frequent and less extensive than are alterations in their deployment in relation to office work and organizational roles (partly because they are so well defined in the former respects and partly because of the expense involved in tool modification). Moreover it would appear from the reports of implementation efforts cited above that organizations do not typically have a blueprint for what fully operationalized office information systems look like that guides the change process and helps determine what sorts of variability are admissible. Rather a set of outcomes is intended (e.g., saved time, improved productivity, reduced costs), but it is uncertain just how (or whether) system capabilities will be actualized within a given office setting to achieve those aims. Consequently it is more feasible to consider implementation of computer-based office information systems from a "mutual adaptation" than from a "fidelity standpoint." That is, successfulness of attempts to introduce such innovative systems should be assessed in terms of degree of utilization and extent to which changes in the system and the organizational context during the implementation process promote the objectives initially intended.

III. APPLICATION OF PRIOR RESEARCH TO OFFICE INFORMATION SYSTEMS

A review of previous research on innovation suggests the appropriateness of an implementation approach for studying the introduction of computerized procedures in office settings. Such an approach should rely on the construct of mutual adaptation, inquiring how technological systems and their organizational contexts are changed during the implementation process. The remainder of this section attempts to specify more precisely the implications to be drawn for future research related to implementation of office information systems.

<u>The organizational context</u>. It is evident from previous research that studies of office information systems must take the context of implementation into account and that, in fact, the appropriate level for unit of analysis is organizational rather than individual. However, once attention shifts away from the individual level that characterized older R&D and problem-solving approaches, it is not immediately clear where to delimit the unit of study and the context in which it is embedded. For example, the extensive case survey of technological innovations in public agencies by Yin et al. (1976) reports that there are no established criteria for distinguishing an organizational unit and its context. Rather, a wide variety of organizational characteristics and levels have been suggested for study, and the list "can continue endlessly" to include not only the innovating organization but ever larger social entities of which it is a part, including city, state, geographic region and the like. Analogous comments hold for private sector research in general (cf. Katz and Kahn, 1978), and for research on innovative automated information systems in particular (cf. Danziger and Dutton, 1977).

For research on office information systems, however, it would seem that the most viable approach is to treat "the office" as the unit of analysis, taking the larger organization of which it is a component as the context of innovation. First, according to Eveland and Rogers (1980), while organization-wide characteristics may be statistically predictive of innovation they "are probably not very helpful in understanding the innovation process." Intraorganizational analyses have revealed that implementation behaviors are not uniformly distributed throughout an organization; rather some parts are likely to be highly involved in the innovation while others have never heard of it (Eveland, 1979). Consequently, the focus of attention for understanding implementation needs to be on the innovating component. Second, an office constitutes a proper instance of what is called in organizational research literature a "work unit," where work units are defined as groups of four or more persons representing at least two different status levels and whose work is organized by output and by workflow

technology (cf. Dewar and Hage, 1978; Rousseau, 1980). This definition is also congruent with the concept of "the office" assumed in most research related to computerized office procedures (cf. Ellis and Nutt, 1980; Barber, 1980; Fikes and Henderson, 1980), permitting an easy transfer of concepts from organizational change studies to the change studies contemplated here.

In the present instance, the workflow technology of interest is a computer system and the output is assumed to be some sort of information (reports, orders, messages, decisions, and the like). The broader context in which the innovating unit is embedded can then logically be limited to the organization for which the office is a unit (cf. Rousseau, 1980). Whether the organization is associated with a product or a service, the office is associated with information and communications. That is, "office work" is believed to consist of relatively homogeneous information handling activities such as filing documents, performing computations, preparing reports, writing memos, responding to requests, completing forms, and so on (Ellis and Nutt, 1980). For instance the application structure of an insurance company is probably concerned with policies, claims, and actuarial tables, while that of a pharmaceutical firm may concern orders, inventories, and bills; but both will want to perform similar kinds of tasks upon entities in the application domain and automated office information systems are supposed to be able to enhance or replace them (Barber, 1980; De Sousa, 1981). Organizations, then, can vary broadly while still allowing offices, as units of study, to be fairly comparable. Finally, features of the broader environment (e.g., urbanness of the site, population size and stability, socio-economic health of the area) necessarily condition the effort to innovate but may be regarded as exogenous variables that are not per se required for understanding the implementation process. In any given research design, then, variables representing the broader environment could either be systematically included and studied or held constant.

In contrast, variables capable of representing features of the office unit and its organizational context that are likely to impact on the technology/performance relationship should be of greatest

interest. The selection of such variables is aided by a tradition of research in modern organizational theory addressed directly to that issue (Woodward, 1965). That research supports the thesis that dimensions of organizational structure most significantly influence the technology-performance relationship (see Davis and Taylor, 1979; Katz and Kahn, 1978; Rousseau, 1980; Perron, 1970; and the very careful review by James and Jones, 1976). Not surprisingly, such variables are virtually identical to those singled out for study by the problem-solving approach to implementation and discussed in that section above under the headings "organizational structure" and "work design" (e.g., degree of centralization, hierarchization, formalization, specialization, interdependence, openness). The convergence of these two lines of research on a congruent set of variables likely to be important in explaining outcomes of attempts to introduce automated information systems in office settings lends confidence in their usefulness for future implementation studies.

The innovative system. Unlike organizational variables, information system variables cannot be recommended for study on the basis of a long social research tradition. Most published research on technological innovation has either followed the development and diffusion of a single prototype system or device (see von Hippel, 1976; Yin et al., 1976; NSF, 1973) or else has focused on classes of technological innovations too generic to be of help in constructing specific system variable measures for this study (see Berman and McLaughlin, 1974, 1975; HIRI/NIMH, 1976). Among the sources reviewed, Kling (1978), Danziger and Dutton (1977), Yin et al. (1976), and Colton (1979) specifically examine implementation of automated information systems; however, they do not differentiate the class of such systems nor provide many measures of system-specific features likely to influence implementation. On the other hand, considerable research and development effort has been invested in automated information systems to support office work from the point of view of system designers (e.g., Barber, 1980; Fikes and Henderson, 1980; Ledgard et al., 1980; Goldstein and Bobrow, 1980; Ball and Hayes, 1980; Winograd, 1979;

Gruenberger, 1981; and the review by Ellis and Nutt, 1980). While these sources describe and explain system features likely to affect their usefulness in office settings, they do not investigate outcomes of their implementation. Consequently, the discussion of innovative system variables and their potential impact on implementation is more speculative.

An automated office system, for purposes of this discussion, is regarded as comprising a multifunction computer system that performs some of an office unit's information handling tasks (e.g., storage, retrieval, manipulation, control) in interaction with its users (cf. Winograd, 1979; Ellis and Nutt, 1980). Such systems may be as limited as a group of independent word processors communicating only by the manual transfer of floppy disks, or as complex as a distributed set of large, communicating computers. Within these extremes are systems involving a central computer with several interactive terminals and sets of small networked computers. What distinguishes office information systems from closely related technologies is that they encompass a number of autonomous parts whose tasks depend on user interaction and can be executed in parallel (Ellis and Nutt, 1980). For research on implementation of such systems, at least two guidelines can be suggested for selecting variables of interest. First, system features should be relevant to a wide range of organizations in which innovating offices may be embedded and thus must be independent of the organization's "subject domain" (Winograd, 1979) or "applications" (Ellis and Nutt, 1980; Barber, 1980). Likewise, variables in a study of implementation processes should represent features that could impact directly on users (cf. von Hippel, 1976), so that internal hardware properties related to storage or manipulation of information (e.g., the specific choice of CPU or wordlength) are not of interest. In variable selection, then, it is appropriate to give attention primarily to features of the user interface or user-system "interaction domain" (Winograd, 1979).

Accordingly, three broad classes of variables likely to affect outcomes of implementation can be recommended as important for future

research on the introduction of computerized information procedures in office settings. First are variables representing input and display properties, and any other features of the workstation technology that support human interaction with automated information (e.g., separable keyboards, light pens, high resolution displays, and the like). Research reported by Barber (1980) and Bair (1978) establishes that it is feasible to conduct an equipment feature analysis and a detailed weighted-features checklist that can be scored using vendors' documentation is available in Bair. On the other hand, some sources have taken a global approach, simply asking users to rate their equipment in terms of satisfactoriness of performance on a few major dimensions (Zisman, 1981). Clearly, options representing intermediate levels of specification could be devised as well. It is worth noting that, except for these user support features of workstations, there does not appear to be a great range of choice among basic multiterminal systems; the survey of corporate users reported by Zisman, for example, yielded only three popular types. The lack of basic variety may perhaps be explained by the fact that there are not a great many producers of such systems. (Stoneman, in his 1976 study of the diffusion of digital computers in private sector corporations in the U.S., found that one manufacturer dominated the field; he attributed the homogeneity of his findings in part to this circumstance.)

A second area of variation potentially important for understanding how systems themselves affect the implementation process concerns application types. Here "application types" represents what the system is used for, independently of specific application domains of organizations and independently of specific commercial software packages; it refers to what information systems do in the way of task enhancement or task replacement for office members (cf. Barber, 1980; Zisman, 1981). From this "knowledge engineering" perspective, all such systems are functionally interconnected sets of devices that will enter, edit, manipulate, and distribute information (De Sousa, 1981); they can be expected to vary in the types of tasks about which these capabilities are deployed ranging, for instance, from document preparation to

electronic filing to decision support. Colton (1979), for example, collected descriptions of tasks performed by police department computers and ranked them along a continuum from "routine" (i.e., relatively straightforward and repetitive information handling by a prescribed procedure) to "nonroutine" (i.e., relatively complex tasks such as decision and planning aids for which no standardized formal procedures can be repetitively applied by users). Danziger and Dutton (1977) devised a four-category ordinal variable including record keeping, calculating/printing, sophisticated analysis, and process control, interpreted as representing increasing levels of "sophistication." Both Fikes and Henderson (1980) and Ellis and Nutt (1979) describe application type in terms of what it presupposes about the nature of the user's work (executing specified procedures vs. problem-solving or planning). These studies suggest the feasibility of representing computer system functions in terms of kinds and complexity of activities performed as well as nature and level of user interaction in task guidance.

The third class of variables proposed for consideration in understanding implementation has to do with an information system's habitability and extensibility. These two terms should be understood as referring to what the system does for users to facilitate its use and what users do to the system to modify its use, respectively. "Habitability" designates properties of softwares often described in terms of "user friendliness" because they are intended to assist interaction with nonexpert users (i.e., individuals whose formal training has not included programming, data processing, or other activities requiring computer use). Included among such properties are error recovery processes designed for ease of correction by the user (e.g., in response to user error a system may crash, print an error message, supply an intelligent correction procedure, and so on). Besides error management alternatives, systems may also differ in respect to a number of other conveniences (e.g., truncated entry). The former "friendliness" features appeared in the commercial market earlier than the latter, and it is not clear how widely distributed

they are (cf. Gruenberger, 1981; Ball and Hayes, 1980; Winograd, 1979; Ledgard et al., 1980). Nevertheless, habitability would seem important to assess because of its assumed relationship to comprehensibility or difficulty of use, a characteristic found in previous research to affect implementation of technological innovations. Similarly, extensibility properties, or kinds of extensions in capability that are possible for the software system as provided by the vendor (e.g., permitting users to program new code, to define sequences of commands, and so on) may not yet be commonly available in much variety (cf. Mosher, 1980; Wagner, 1980). However, such properties are important because they seem to represent the system's potential for adaptive change by its users, a condition also found to be significantly related to implementation of technological innovations.

The preceding discussion does not pretend to exhaust the classes of variables representing computer system characteristics that can affect implementation; it merely provides some examples of variables that can be drawn from extant literature. It assumes that characteristics of greatest interest are those most salient to users when interaction with electronic information technology (or with another individual via such technology) replaces interaction with more traditional devices (telephones, typewriters, file cabinets) or with coworkers directly.

The implementation effort. In Bardach's (1977) terms, the implementation effort may be viewed as a process of putting a machine together and making it run--mental health machines, educational machines, organizational machines; says Bardach, "at an intermediate level of abstraction, one can see that all such machines look rather similar." The review of previous approaches to innovation research strongly supports the view that characteristics of the implementation effort are most likely to differentiate successful and unsuccessful deployment of information technology in office settings. However, as Yin et al. (1976) commented, this research orientation is "preparadigmatic" and there does not exist an already developed body of standard measures that can simply be applied to the question of

understanding successful and unsuccessful efforts to implement electronic information systems. On the other hand, there does exist a relatively consensual set of key concepts for investigation (see above) if previous implementation findings generalize to the issue of interest here.

Danziger and Dutton (1977) raise the question of "whether there is anything unique or special about computers as technological innovations." A suggestive, although not conclusive, response can be framed on the basis of existing research. Danziger and Dutton (1977), on the basis of their study of local governments, favor the uniqueness hypothesis; they found that variables typically having strong impact on outcomes had little or no influence on implementation of computerized procedures in these settings, while larger environment factors (the geographic, social, political and economic milieux) had much more effect. In contrast, Yin et al. (1976), in their study of innovations in public agencies, treated computer systems as one of three generic types of local government innovations; the set of predictor variables employed was no less able to account for variation in outcomes for that type of technological innovation than for the other two (hardware devices and data systems). In conjunction, these studies suggest that the extra-organizational environment may have more impact on implementation in public than in private sector settings; they do not, however, support the claim for the uniqueness of computer systems as technological innovations. Consequently, there is reason to believe that explanatory variables drawn from previous research and discussed above in relation to the implementation approach are appropriately applied in an attempt to understand processes involved in the introduction of computer-based information systems in office settings.

In these settings, reasons for introducing innovative technology as well as the roles of key actors and incentives for users take on renewed interest as explanatory constructs. Most sources (e.g., McCormick, 1980; Yin et al., 1976; NSF, 1973) find that <u>reasons for introducing innovative technology</u> can be categorized on the basis of whether they represent technological opportunity (for instance,

declining entry costs, smaller systems becoming available, varied applications packages) or recognized need (for instance, to process claims faster, to reduce costly errors, to update information rapidly). The consensus from previous research is that recognition of a technological opportunity in the absence of a clear organizational need to be served by such innovation is not likely to lead to successful implementation. Further, Young (1980) and Berman and McLaughlin (1975) found that degree of specificity or organizational objectives for innovation was positively associated with implementation outcomes. Finally, Yin et al. (1976) reported that objectives involving improved outputs were more strongly associated with implementation success than objectives defined by cost reduction.

Once the adoption decision has been made, the roles of key actors and incentives for users in the implementation process probably contribute heavily to outcomes. Key actors are those who control critical decisions regarding how the new system is to be introduced and used (cf. Danziger and Dutton, 1977; Pressman and Wildavsky, 1973). While previous research consistently reports that the support of key actors is necessary to successful implementation, their roles in relation to computerized information systems are uncertain. For example, a 1973 NSF study found strong effects for the presence of a technological entrepreneur and much weaker effects for a managerial leader. Similarly, Danziger and Dutton (1977) found that support of top management produced only very weak effects, while positive outcomes were associated with decisional control in the hands of the unit head. These results are not surprising; a Booz-Allen and Hamilton survey (Modern Office and Data Management, May 1980) found that many managers who are responsible for initiating and guiding automation are not trained in that field.

Concomitantly, the incentives and counterincentives for change within office units need consideration, because implementation requires a great deal of "people-based support" (Fullan and Pomfret, 1977). During the process of installing an innovation in any setting, most of

the discretionary choices are made "at the bottom" (Elmore, 1979), yet the collective effect of such choices has a great deal to do with the outcomes of the implementation effort. Previous investigations (e.g., Yin el al., 1976; Kling, 1978; Berman and McLaughlin, 1975) have established two types of incentives or counterincentives for innovation: to increase production efficiency (by improving putputs, decreasing costs, and the like), and to enhance bureaucratic self-interest (related to retention or increase of social power). The two orientations often imply different or contrary behaviors. Yin et al. (1976) argue that in the private sector the "perpetuation of bureaucratic status" is negligible, since increasing effectiveness is always the predominant incentive. In contrast stands the position of Kling (1980), who cites a number of private sector examples to suggest that social power payoffs in fact often dominate implementation decisions; he cautions that in no case should such organizations be regarded simply as "economic production units." This view is supported by Frank (1980) and by Gruenberger (1981), whose recent Datamation article includes the warning that "If there's a choice between cutting costs and cutting empires, the empire strikes back every time."

Besides the implementation perspectives of organizations, key actors, and others involved, the implementation process may be affected by special characteristics of computer technology. For example, user participation emerges frequently in the literature as a determinant of success. But if computerized information systems are not readily comprehensible to users, securing their participation in planning and decisionmaking may be problematic. On the one hand, the case survey conducted by Yin et al. (1976) suggests that computer systems tend to be introduced all at once; they are not treated as "divisible" innovations even though incremental implementation is possible and might be disirable from the user standpoint (cf. Carlisle, 1979). Nevertheless, the literature cites cases in which users were involved in initial needs-assessment stages (von Hippel, 1976), in decisions about preferred system design features (Driscoll, 1979), and

both pre- and post-adoption planning (Magnus, 1980).

Training, another implementation effort variable established by prior research to influence outcomes of implementation, might well be facilitated by the nature of computer technology. That is, it is possible to provide on-line system documentation and training manuals. Further, learning exercizes that are game-like can be made available for practice purposes (cf. Gutek, 1981) while journalling can be used for feedback and self-evaluation purposes (cf. Hagelstrom, 1980). A third technology-relevant issue has to do with the mutual adaptation of the work unit to conform to system requirements and of the system to meet office needs and desires. While such reciprocal adaptations are viewed as positive implementation influences on the basis of past research, their feasibility in relation to computer systems after their first introduction into office settings merits attention. A recent report by Winograd (1979) for example, emphasizes the importance of software that is responsive to user needs. At the same time it points out that modifying extant programs and packages for that purpose is typically extremely difficult and costly, citing one instance in which modification cost "exceeded the original development cost by a factor of 100." From the "soft technology" perspective, however, Johnson and Taylor (1981) find mutual adaptation not unlikely as implementing organizations modify task structures and procedures and as users find creative ways of employing machine capabilities for purposes not anticipated at the time of adoption.

IV. POLICY IMPLICATIONS

The purpose of this literature review is to provide a foundation for research on the introduction of computerized procedures into office settings. Such research could yield two general sorts of policy recommendations: those addressed to implementation of electronic information systems in particular, and those more broadly addressed to implementation of technological innovations in organizational settings. In both instances the policy issue is what sorts of individual and organizational behavior should be encouraged (cf. Eveland, 1979). The

two classes of recommendations are of interest because the federal government has heavily invested in the transfer of technological innovation across various sectors (Tornatzky et al., 1980) and because automated information systems are a timely and far-reaching instance of such transfer.

Most large corporations and government agencies are planning or implementing office information systems, a change that will affect the majority of the work force in the not very distant future. To the extent that research can provide information on how the outcomes will be affected by system, organizational, and implementation variables, the resultant recommendations should benefit three audiences: (1) Researchers, developers, and producers of the technology should find them useful. While results would not bear directly on any one product, they should generalize across a range of office environments and add value to what is developed and distributed by the private sector. The need for including system variables in implementation research has been explicitly recognized by this community (e.g., Barber, 1980). (2) Organizational and individual users can also be expected to benefit. Keen's (1981) recent review of social impacts of computing cites many cases that were at once technical successes and organizational failures, calling attention to ways in which the social context of implementation "damps out the intended effects of technological innovations." For this reason considerable attention should be given to assessment of organizational implementation strategies, together with their impact on the design of work, worker well-being, and productivity. (3) Finally, if information systems are used effectively, the ultimate research beneficiary is the consumer of goods and services. Toward this end, the effects of such innovation on organizational productivity and effectiveness should be studied to determine what value should be attached to stimulating utilization.

Recommendations can also be framed at a more general level for policymakers and decisionmakers in the public and private sectors related to the implementation of sociotechnical systems in

organizational settings. As Tornatzky et al. (1980) note, "empirically we still know very little about change and innovation in complex organizations"; they conclude, therefore, that in order to transfer technologies and practices of any sort that demand extensive and difficult alterations of behavior, thoroughgoing organization-process-oriented research on utilization may be needed. Further, policy research should take a new look at implementation incentives, particularly those of users (what users should do and how they will benefit), because the success of any innovation hinges on their support. Consequently, as Tornatzky et al. (1980) point out, there is a need for investigations focused on group dynamics and other organizational processes that affect the adopting unit. Yin (1978) suggests that the major conditions leading to incorporation are all internal to the local organization. If so, external initiatives should perhaps be deemphasized, with policy expressed instead in terms of how-to's, or operational procedures and recommendations (cf. Fullan and Pomfret, 1977).

The literature yields several reasons for thinking that the federal government will fare poorly as an instrument of organizational change. First, federal officials have limited knowledge of what incentives will be effective in a local context (Berman and McLaughlin, 1974). Second, the federal government has few incentives to offer--a situation not likely to improve (Bardach, 1977). Finally, federal incentives have not operated well in this arena; a move from regulatory and hierarchical to delegated and local programmatic approaches would do more to support innovation (Elmore, 1979; Fullan and Pomfret, 1977).

Given this line of reasoning, the form of policy recommendations stemming from the type of research suggested here would be similar for findings related both to implementing automated office information in particular and to implementing technological innovations in general, regardless of whether they are directed toward the public or private sector. That is, they should specify what kinds of antecedents (characteristics of the innovation, the organizational structure, and the implementation effort) should be instituted in order to attain the desired outcomes of planned change.

BIBLIOGRAPHY

Aiken, M., S. B. Bacharach, and J. L. French, "Organizational Structure, Work Process, and Proposal Making in Administrative Bureaucracies," Academy of Management J., Vol. 23, 1980, pp. 631-652.

Anderson, H., "What's Here, What's Ahead," Administrative Management, Vol. 39, No. 8, Aug. 1978, pp. 30-32.

Anderson, R. E., and J. T. Mortimer, Sociology of Computer Work: Introduction, University of Minnesota (Unpublished manuscript), Dec. 1978.

Anonymous, "Boosting Productivity at the Top," Business Week (Industrial Edition), No. 2645, July 14, 1980.

Anonymous, "Distributors Keep Their Cool as Xerox Puts Stores in Dallas," Business Forms Reporter, Vol. 18, No. 7, July 1980, pp. 22, 78.

Anonymous, "Distribution Network Increases Word-Processing Productivity," Modern Office Procedures, Vol. 25, No. 11, Nov. 1980, pp. 142-146.

Anonymous, "Evaluating Off-the-Shelf Programs," Datamation, Vol. 26, No. 12, 1980, pp. 85-122.

Anonymous, "How Not to Exploit the Hardware," Business Week, No. 2629, Mar. 24, 1980, pp. 90-92.

Anonymous, "Now It Is the Manager's Turn to Increase Productivity," Modern Office and Data Management, Vol. 19, No. 4, May 1980, pp. 4-6, 10.

Anonymous, "Office Technology to Involve Both Boss and Secretary," Marketing News, Vol. 13, No. 5, Sept. 7, 1979, pp. 10-11.

Arends, J. H., et al., Evaluation Design for the Establishment of a Technical Assistance Unit in the Improving Teaching Competencies Program (Report to NIE), Northwest Regional Educational Laboratory, Portland, Oregon, 1976.

Bailey, Gerald C., Peter G. Norlie, and Frank Sistrunk, "Teleconferencing: Literature Review, Field Studies, and Working Papers," Catalog of Selected Documents in Psychology, Vol. 3, Human Sciences Research, Inc., Institute for Defense Analyses, Arlington, VA., Fall 1973.

Bair, J. H., "Productivity Assessment of Office Information Systems Technology," Trends and Applications: 1978 Distributed Processing, National Bureau of Standards, Gaithersburg, MD, 1978.

Ball, E., and P. Hayes, "Representation of Task-Specific Knowledge in a Gracefully Interacting User Interface," NCAI, 1980, pp. 116-120.

Barber, Gerald R., "Reasoning About Change in Knowledgeable Office Systems," NCAI, 1980.

Barber, G. R., Record of the Workshop on Research in Office Semantics, MIT Laboratory for Computer Science, Cambridge, MA, June 15-18, 1980.

Bardach, E., "On Designing Implementable Programs," in G. Majone and E. S. Quade, Eds., Pitfalls of Analysis, John Wiley & Sons, New York, 1980.

Bardach, E., The Implementation Game, MIT Press, Cambridge, MA, 1977.

Barker, P., T. K. Bikson, and J. Kimbrough, A Study of Alternatives in American Education, Vol. V: Diversity in the Classroom, The Rand Corporation, Santa Monica, CA, R-2170/5-NIE (Final Report to the National Institute of Education), 1981.

Barradell, P., F. J. Bennett, S. Bentham, J. G. A. Clarke, and P. Mills, "Selection and Evaluation of Word Processing Equipment in a Research Organization," R&D Management, Vol. 9, No. 1, 1978, pp. 9-12.

Bell, D., The Coming of the Post-Industrial Society, Basic Books, New York, NY, 1978.

Bennis, R. E., "Telecommunication," Administrative Management, Vol. 41, No. 1, Jan. 1980, p. 90.

Bennis, W. G., "Changing Organizations," in H. A. Hornstein, B. B. Bunker, W. W. Burke, M. Gindes, and R. J. Lewicki (eds.), Social Innovation: A Behavioral Science Approach, The Free Press, New York, 1971.

Bergeron, L. L., "Word Processing Survey," J. of Systems Management, Vol. 26, No. 3, 1975, pp. 20-24.

_______, "Managing a Correspondence Center," J. of Systems Management, Vol. 26, No. 9, Sept. 1975, pp. 22-25.

Berman, Paul, "Designing Implementation to Match Policy Situation: A Contingency Analysis of Programmed and Adaptive Implementation," Paper presented to the American Political Science Association, 1978.

Berman, Paul, and M. McLaughlin, Federal Programs Supporting Educational Change, Vol. I: A Model of Educational Change, The Rand Corporation, R-1589/1-HEW, 1974.

______, Federal Programs Supporting Educational Change, Vol. II: Factors Affecting Change Agent Projects, The Rand Corporation, R-1589/2-HEW, 1975.

______, Federal Programs Supporting Educational Change, Vol. IV: The Findings in Review, The Rand Corporation, R-1589/4-HEW, 1975.

______, Rethinking the Federal Role in Education, The Rand Corporation, P-6114, 1978.

_______, An Exploratory Study of School District Adaptation, The Rand Corporation, R-2010-NIE, 1979.

_______, Adaptation With and Without Change, The Rand Corporation (Report forthcoming).

Bikson, T. K., Getting It Together: Gerontological Research and the Real World, P-6447, The Rand Corporation, 1980.

Bikson, T. K., S. E. Berryman, and J. Bazemore, Cable, Two-Way Video, and Educational Programming: The Case of Daycare, The Rand Corporation, R-2270-NSF, 1978.

Birks, G., "Electronic Mail--Its Use in a Corporate Information-Center Network," Proceedings of the American Society for Information Science, Vol. 17, 1980, pp. 41-43.

Boruch, R. F., and H. Gomez, "Sensitivity, Bias, and Theory in Impact Evaluations," Professional Psychology, Vol. 8, No. 4, 1977, pp. 411-434.

Brown, W. M., et al., SEMTAP: A New Technology Transfer Network to Link Business and Industry with Federal Research and Development, Environmental Research Institute of Michigan, Ann Arbor, MI., 1977.

Burke, W. H. "Word Processing--Concept and Implementation," Forum, Vol. 10, No. 1, 1974, pp. 447-451.

Cammann, C., M. Fichman, G. D. Jenkins, Jr., and J. R. Klesh, "The Michigan Organizational Assessment Questionnaire," Michigan Organizational Assessment Package, Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI., 1978.

Carlisle, James, "Office of the Future: More Than New Technology?" Computerworld, Vol. 13, No. 45, Nov. 5, 1979, p. 38.

Cherns, A., "The Principles of Sociotechnical Design," Human Relations, Vol. 29, No. 8, 1977, pp. 783-792.

Citicorp Management Work Station Standards, Citibank, 153 East 53rd Street, New York, NY, April 1977.

Clark, D. L., and E. G. Guba, Innovation in School Curricula, National Educational Association, Center for the Study of Instruction, Washington, D.C., 1965.

Clutterbuck, D., "Word-Processing Ends Company Paper Chase," International Management, Vol. 33, No. 6, June 1978, pp. 39-40.

Cockroft, D., "Chips With Everything: How New Technology Affects You: Commerce," Personnel Management, Vol. 11, No. 6, June 1979, p. 32.

Coleman, J. S., "Conflicting Theories of Social Change," in G. Zaltman (ed.), Processes and Phenomena of Social Change, Wiley and Sons, New York, NY, 1973.

Colton, Kent W., "The Impact and Use of Computer Technology by the Police," in R. Kling (ed.), Communications of the ACM, Vol. 22, No. 1 Jan. 1979.

Connell, J. J., "The Office of the Future," J. of Systems Management, Vol. 30, No. 2, Feb. 1979, pp. 6-10.

_____, "The Need for New Office Research," Management World, Vol. 9, No. 1, Jan. 1980, p. 24.

_____, "The 'People Factor' in the Office of the Future," Administrative Managment, Vol. 41, No. 1, Jan. 1980, pp. 36-37.

_____, "Office of the Future," The Executive, May 1980, p. C1.

_____, "Office Tools Salvage 15% of Users' Time," Computerworld, Sept. 28, 1980, p. SR/2.

_____, "Office of the Future," The Executive, Nov. 1980, pp. 48-49.

Coopers and Lybrand, "Office of the Future Amalgamates People, Equipment, Systems," Coopers and Lybrand Newsletter, Vol. 21, No. 10, 1979, pp. 4-6.

_____, "White Collar Workers, Contrary to Much Current Belief, Think They Would Work Better Under Improved Conditions," Coopers and Lybrand Newsletter, Vol. 21, No. 9, 1979, pp. 5-6.

Cronbach, L. J., G. C. Gleser, H. Nauda, and N. Rajaratram, The Dependability of Behavioral Measurements, Wiley & Sons, New York, NY, 1972.

Dalleyrand, M. R., and H. Voos, "Role of Information Science in the Office of the Future Concept--Introduction," Proceedings of the American Society for Information Science, Vol. 16, 1979, p. 297.

Dalton, D. R., W. D. Todor, M. J. Spendolini, G. J. Fielding, and L. W. Porter, "Organization Structure and Performance: A Critical Review," Academy of Management Review, Vol. 5, 1980, pp. 49-64.

Danziger, James N., and William H. Dutton, "Computers as an Innovation in American Local Governements," in R. Kling (ed.), Communications of the ACM, Vol. 20, No. 12, Dec. 1977.

Davis, H. R., "A Checklist for Change," A Manual for Research Utilization, in National Institute of Mental Health, Government Printing Office, Washington, D.C., 1971.

Davis, L. E., and J. C. Taylor, "Technology and Job Design," in L. E. Davis and J. C. Taylor (eds.), Design of Jobs (Second Edition), Goodyear Publishing Company, Santa Monica, CA., 1979.

den Hertog, F., and F. M. Van Eijnatten, "Job Consequences of Technological Choices in Industry: A Design Perspective," Paper presented at N.A.T.O. Conference on Quality of Working Life, Thessaloniki, Greece, Aug. 1979.

"Dennison Research Report: The Impact of Technology on the Office of the Future," Geyer's Dealer Topics, Jan. 1979, pp. 53-62.

De Sousa, M. R., "Electronic Information Exchange in an Office Environment," IBM Systems Journal, Vol. 20, No. 1, 1981, pp. 4-22.

Devore, J. C., "Small Computers Help Small Operations," Industrial Engineering, Vol. 11, No. 4, April 1979, pp. 22-28.

Dewar, R., and J. Hage, "Size, Technology, Complexity and Structural Differentiation: Toward a Theoretical Synthesis," Administrative Science Quarterly, Vol. 23, 1978, pp. 111-136.

Dickey, S., "Impact II - Toward the Office of Tomorrow," Management World, Vol. 8, No. 11, Nov. 1979, p. 19.

Driscoll, James W., "People and the Automated Office," Datamation, Vol. 25, No. 12, Nov. 1979, pp. 106-112.

Eldon, M., Personal Communication, September 1980.

Ellis, Clarence A., and Gary J. Nutt, "Office Information Systems and Computer Science," Computing Surveys, Vol. 12, No. 1, March 1980.

Elmore, Richard F., "Complexity and Control: What Legislators and Administrators Can Do About Implementation," Public Policy Paper No. II, Institute of Governmental Research, University of Washington, Seattle, April 1979.

Elmore, R. F., "Organizational Models of Social Program Implementation," Public Policy, Spring, 1978.

Emery, F. E., and E. L. Trist, "Technical Systems," in C. Churchman and M. Verhulst (eds.), Management Sciences, Models and Techniques: Vol. II, Pergamon Press, London, England, 1960.

Eveland, J. D., "Issues in Using the Concept of 'Adoption of Innovations,'" Journal of Technology Transfer, Vol. 4, No. 1, 1979, pp. 1-13.

Eveland, J. D., and E. M. Rogers, Measuring the Innovation Process in Public Organizations, December 20, 1980.

Farr, R., Knowledge Linkers and the Flow of Educational Information, Stanford University, ERIC Clearinghouse on Educational Media and Technology, Stanford, CA., 1969.

Fikes, R. E., and D. A. Henderson, Jr., "On Supporting the Use of Procedures in Office Work," NCAI, 1980, pp. 202-207.

Follett, B. L., "Word Processing to Computer-Software Interfaces," J. of Micrographics, No. 5, 1980, p. 15.

Ford, J. D., "Institutional Versus Questionnaire Measures of Organizational Structure: A Reexamination," Academy of Management J., Vol. 22, 1979, pp. 601-610.

Forest, Robert B., "Here We Go Again," Infosystems, Vol. 26, No. 9, Sept. 1979, p. 86.

Fortune, J., J. Horwich, and R. Schwartz, "Use of a Word Processor Interfaced to a Mini-Computer to Facilitate Online Searching," Abstracts of Papers of the American Chemical Society, Vol. 1979, April 1979, p. 56.

Frank, Howard, "What to Do While Waiting for Utopia," Datamation, Vol. 25, No. 13, Nov. 25, 1979, pp. 40-44.

Frank, R. A., "Message System Flaws," Datamation, Vol. 26, No. 12, 1980, pp. 78-80.

Fullan, M. and A. Pomfret, "Research on Curriculum and Instruction Implementation," Review of Educational Research, Vol. 47, No. 1, 1977, pp. 335-397.

Gehmlich, R. A., "The Records Management Specialist in the Office of the Future," Records Management Quarterly, Vol. 14, No. 1, Jan. 1980, pp. 5-7.

General Accounting Office. Federal Productivity Suffers Because Word Processing is Mismanaged. Washington, D.C., Government Printing Office, 1979.

Glaser, E. M., "Knowledge Transfer and Institutional Change," Professional Psychology, Vol. 4, 1973, pp. 434-444.

Glaser, E. M., H. S. Coffey, J. B. Marks, and I. B. Sarason, Utilization of Applicable Research and Demonstration Results, Human Interaction Research Institute, Los Angeles, CA., 1967.

______, and H. L. Ross, Increasing the Utilization of Applied Research Results, Final Report to NIMH, Grant No. 5 R12-MH-09250-02, Human Interaction Research Institute, Los Angeles, CA., 1971.

______, and S. Taylor, Factors Influencing the Success of Applied Research, Final Report to NIMH, Contract No. 43-67-1365, Department of Health, Education, and Welfare, Washington, DC, 1969.

_____, and C. G. Wrenn, Putting Research, Experimental, and Demonstration Findings to Use, Office of Manpower Policy, Evaluation and Research, DOL, Washington, DC, 1966.

Glenn, E. N., and R. L. Feldberg, "Degraded and Deskilled: the Proletarianization of Clerical Work," Social Problems, Vol. 25, 1977, p. 52-64.

Gordon, Jesse E., et al., Putting Social Science Knowledge to Use in the Manpower System: An Overview Report, National Technical Information Service, Springfield, VA, 1974.

Gottheimer, D., "Business Systems: 1979 Overview," Dun's Review, Vol. 113, No. 3, Mar. 1979, pp. 15-16.

Green, H. P., "Technology Assessment and Democracy: Uneasy Bedfellows," Business and Society Review, Vol. 5, 1973, pp. 72-80.

Green, L. A., Educational Technology Dissemination Project: A Project in Selected Methods of Disseminating Information Regarding Educational Media by State Departments of Education, Colorado State Department of Education, Denver, CO, 1966.

Groot, H. C., "A Diachronic Communications Construct for Information Systems Analysis in Development," Paper presented to the International Communication Association, 1971.

Grove, G., "Information Management in the Office of the Future," Management Review, Vol. 68, No. 12, Dec. 1979, pp. 47-50.

Gruenberger, Fred, "Making Friends with User-Friendly," Datamation, January 1981, pp. 108-112.

Guba, E., and H. Brickell, Conceptual Strategies for Utilizing R&D Development Products in Education, Occasional Paper #2, Ohio State University, Columbus, OH, 1974.

Gutek, B. A., "The Relative Importance of Intrapsychic Determinants of Job Satisfaction," Paper presented at NATO Conference on Quality of Working Life, Thessalonika, Greece, Aug. 1979 (Reprinted in K. Duncan, M. Gruneberg, and D. Wallace (eds.), Changing Life at Work, Wiley and Sons, London, England, 1980.

Gutek, B. A., The Senior Manager's Work Station: Attitudinal and Behavioral Effects on Users. Internal Report, Advanced Development Laboratory, Palo Alto Research Center, Xerox Corporation, 1981.

Hackman, J. R., and J. L. Suttle, Improving Life at Work: Behavioral Science Approaches to Organizational Change, Goodyear Publishing Company, Santa Monica, CA, 1977.

Hage, J., and M. Aiken, "Relationships of Centralization to Other Structural Properties," Administrative Science Quarterly, Vol. 12, 1967, pp. 72-92.

Hagelstrom, Sharon, "Work Measurement Justifies a New Word-Processing System," Modern Office Procedures, Vol. 25, No. 11, Nov. 1980, pp. 136-140.

Haight, G. M., "Word Processing Goes to College," Management World, Vol. 8, No. 11, 1979, pp. 12-18.

Hall, G., and S. A. Loucks, A Developmental Model for Determining Whether or Not the Treatment is Really Implemented, Research and Development Center for Teaching Education, University of Texas at Austin, 1976.

Hansen, R., "Word Processing: How It's Changed Us, Where We Go from Here," Administrative Management, Vol. 38, No. 6, June 1977, pp. 33-35.

Havelock, R. G., New Development in Translating Theory and Research into Practice, Paper presented to the American Public Health Association, 1968b.

_____, *The Change Agent's Guide to Innovation in Education*, Educational Technology Publications, Englewood Cliffs, NJ, 1973.

_____, Ideal Systems for Research Utilization: Four Alternatives, Social Rehabilitation Service, DHEW, Washington, DC, 1974.

_____, Planning for Innovation through Dissemination and Utilization of Knowledge, Final Report on Contract No. OEC-3-7-070028-2143, Office of Education, DHEW, Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1969.

_____, "Dissemination and Translation Roles," in T. L. Eidell and J. M. Kitchel (eds.), Knowledge, Production and Utilization in Educational Administration, Center for the Advanced Study of Educational Administration, University of Oregon, Eugene, OR, 1968a.

Havelock, R. G., and D. A. Lingwood, R&D Utilization Strategies and Functions: An Analytical Comparison of Four Systems, University of Michigan, Institute for Social Research, Ann Arbor, MI, 1973.

Havelock, R. G., and F. C. Mann, Research and Development Laboratory Management Knowledge Utilization Study, Final Report on Contract No. AF49(638)1732, Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1968.

Hildebrand, E. P., Four State Diffision Project, Final Report to the National Center for Educational Research and Development, Colorado State Department of Education, Denver, CO, 1971.

Hill, Roy, "How Companies are Adapting to New Office Technology," International Management (UK), Vol. 35, No. 7, July 1980, pp. 39-42.

Holmes, F. W., "IRM - Organizing for the Office of the Future," J. of Systems Management, Vol. 30, No. 1, 1979, pp. 24-31.

Human Interaction Research Institute and the National Institute for Mental Health, Putting Knowledge to Use: A Distillation of the Literature Regarding Knowledge Transfer and Change, National Institute of Mental Health, Rockville, MD, 1976.

Inkson, J. H., D. S. Pugh, and D. J. Hickson, "Organizational Context and Structure: An Abbreviated Replication," Administrative Science Quarterly, Vol. 15, 1970, pp. 318-329.

International Data Corporation, "Business Communication: Alternatives for the Eighties," Fortune Magazine, February 25, 1980, pp. 25-46.

International Resource Development, Inc. Local Networks and Short Range Communications. Norwalk, Connecticut, 1981.

James, L. R., and A. P. Jones, "Organizational Structure: A Review of Structural Dimensions and Their Conceptual Relationships with Individual Attitudes and Behavior," Organizational Behavior and Human Performance, Vol. 16, 1976, pp. 74-113.

Johansen, R., and R. DeGrasse, "Computer-Based Teleconferencing - Effects on Working Patterns," J. of Communication, Vol. 29, No. 3, 1979, pp. 30-41.

Johnson, B. M. and Taylor, J. C. The Process of Reinvention in Office Automation. Proposal submitted to the National Science Foundation, February, 1981.

Jolly, J. A., J. W. Creighton, and P. A. George, Technology Transfer Process Model and Annotated Bibliography, Naval Postgraduate School, Monterey, CA, 1978.

Katz, D., B. Gutek, R. Kahn, and E. Barton, Bureaucratic Encounters: A Pilot Study in the Evaluation of Government Service, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1975.

Katz, D., and R. L. Kahn, The Social Psychology of Organizations (2nd ed.), John Wiley & Sons, New York, NY, 1978.

Katz, D., R. L. Kahn, and J. S. Adams (eds.), The Study of Organizations, Jossey-Bass, San Francisco, 1980.

Keating, Edward T., "Productivity and Information Management," J. of Micrographics, Vol. 13, No. 6, July/Aug. 1980, pp. 16-24.

Keen, P. G. W., "Information Systems and Organizational Change," Communications of the ACM, Vol. 24, No. 1, 1981, pp. 24-33.

Ketron, Roger W., "Four Roads to Office Automation," Datamation, Vol. 26, No. 11, Nov. 1980, pp. 138-140.

Kling, Rob, "Automated Welfare Client-Tracking and Service Integration: The Political Economy of Computing," in H. Morgan (ed.), Communications of the ACM, Vol. 21, No. 6, June 1978.

Kling, R., "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research," Computing Surveys, Vol. 12, No. 1, 1980, pp. 61-111.

Krasan, Victor J., "Enter the Electronic Editor," Management Focus, Vol. 27, No. 6, Nov./Dec. 1980, pp. 2-8.

Lavin, R. J., Establishing Effective Linkages at the Local Education Agency Level, Paper Presented to the American Educational Research Association, 1972.

Law, D. E., and C. L. Pereira, "Word Processing: How to Cut Secretarial Administrative Costs," Management Review, Vol. 65, No. 3, Mar. 1976, pp. 28-35.

Ledgard, Henry, John A. Whiteside, Andrew Singer and William Seymour, "The Natural Language of Interactive Systems," in R. L. Ashenhurst (ed.), Communications of the ACM, Vol. 23, No. 10, Oct. 1980.

Lee, R. S., "Social Attitudes and the Computer Revolution," Public Opinion Quarterly, Vol. 34, 1970, pp. 53-59.

Lester, T., "The Office Conundrum," Management Today, Nov. 1978, p. 117.

Lewis, S. D., "Fighting the Gigo Syndrome in Word Processing," Management World, Vol. 8, No. 11, Nov. 1979, pp. 17-18.

Lingwood, D. A., and R. G. Havelock, "On the Balanced Producer-Client Linkage Exchange," in M. Radnor et al. (eds.), Information Dissemination and Exchange for Educational Innovations, Part Two, Northwestern University Center for the Interdisciplinary Study of Science and Technology, Evanston, IL, 1977.

Lippitt, R., "Dimensions of the Consultant's Job," in W. G. Bennis, K. D. Benne, and R. Chin (eds.), The Planning of Change: Readings in the Applied Behavioral Sciences, Holt, Rinehart and Winston, New York, NY, 1962.

_______, "The Use of Social Research to Improve Social Practice," American J. of Orthopsychiatry, Vol. 35, No. 4, 1965, pp. 663-669.

Lippitt, R., and R. Havelock, "Needed Research on Research Utilization," in Research Implications for Educational Diffusion, Department of Education, Michigan State University, East Lansing, MI, 1968.

Macy, B. A., and P. H. Mirvis, "Measuring Quality of Work and Organizational Effectiveness in Behavioral Economic Terms," Paper presented at the American Psychological Association Convention, New Orleans, LA, 1974.

____, "A Methodology for Assessment of Quality of Work and Organizational Effectiveness in Behavioral Economic Terms," Michigan Organization of Assessment Package, Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1975.

Magnus, Margaret, "Office Automation, Personnel and the New Technology," Personnel J., Vol. 59, No. 10, Oct. 1980, pp. 815-819, 823.

Mankin, D. A., Toward a Post-Industrial Psychology: Emerging Perspectives on Technology, Work, Education and Leisure, Wiley and Sons, New York, NY, 1978.

Marquard, R. J., "Illumination for the Office of the Future," Office, Vol. 92, No. 3, Sept. 1980, pp. 31, 68.

McCabe, H., and E. Popham, "Word Processing--Systems-Approach to Office," J. of Business Communication, Vol. 15, No. 2, 1978, p. 63.

McCormick, Neil, "Automating the Agency: Minis Fill the Bill," Best's Review, Vol. 81, No. 7, Nov. 1980, pp. 78-82.

McIntosh, Lowrie, W., "Prepare for the Office of the Future--With Paper," Industrial Engineering, Vol. 12, No. 7, July 1980, pp. 40-45.

McLaughlin, M., "Innovations in Classroom Organization," Paper presented to the American Educational Research Association, 1975.

Miller, D. C., Handbook of Research Design and Social Measurement (3rd ed.), McKay, New York, NY, 1977.

Mintzberg, H., The Nature of Managerial Work, Harper & Row, New York, NY, 1973.

Mirvis, P. H., and E. E. Lawler, "Measuring the Financial Impact of Employee Attitudes," J. of Applied Psychology, Vol. 62, 1977.

Mirvis, P. H., and B. A. Macy, "Behavioral-Economic Measurement System," Michigan Organizational Assessment Package (Progress Report II), Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1975.

______, "Human Resource Accounting: A Measurement Perspective," Academy of Management Review, Vol. 1, 1976.

Moos, R., and P. M. Insel, Work Environment Scale, Social Ecology Laboratory, Department of Psychiatry, Stanford University, Stanford, CA, 1979.

Morgan, H. L., "Problems and Promises of Office Automation," Paper presented at INFOTECH State of the Art Seminar on Future Networks, London, England, Nov. 16, 1977.

Morgan, M. B., "Office of the Future--Is Management Ready," J. of Systems Management, No. 6, 1980, pp. 28-32.

Morgenbrod, H., and H. Schwartzel, "How New Office Technology Promotes Changing Work Methods," Management Review, July 1979, pp. 42-45.

Mosher, James C., "A Blueprint for Tomorrow's Information Systems," Computerworld, Vol. 14, No. 6, Feb. 11, 1980, pp. 13-24.

Mowshowitz, A., "On Approaches to the Study of Social Issues in Computing," Communications of the ACM, Vol. 24, No. 3, 1981, pp. 146-155.

Myers, C. A. (ed.), The Impact of Computers on Management, MIT Press, Cambridge, MA, 1967.

National Science Foundation, Knowledge into Action: Improving the Nation's Use of the Social Sciences, Report of the Special Commission on the Social Sciences of the National Science Board, Report NSB 69-3, U.S. Government Printing Office, Washington, DC, 1969.

National Science Foundation, Science, Technology, and Innovation, Report on Contract NSF-C667, Batelle Columbus Laboratories, Columbus, OH, 1973.

Ogden, E., and M. Miesumeci, A Taxonomy of Technical Assistance Skills, Capla Associates, Inc., Rochelle Park, NY, 1977.

Oman, R. C., "Cost/Productivity of Automatic/Conventional Typewriters," J. of Systems Management, Vol. 29, No. 7, July 1978, pp. 10-14.

Orcutt, J. D., and R. E. Anderson, "Human-Computer Relationships: Interactions and Attitudes," Behavior Research Methods and Instrumentation, Vol. 6, No. 2, 1974, pp. 219-222.

Patterson, P., "Executives Join the World of Automation," Industry Week, Vol. 206, No. 5, Sept. 1, 1980, pp. 76-78.

Pennings, J. M., "Measures of Organizational Structure: A Methodological Note," American J. of Sociology, Vol. 79, 1973, pp. 686-704.

Perrin, J. R., and C. A. Johnson, Active Technology Transfer, American Institute of Aeronautics and Astronautics, Technical Information Service, New York, NY, 1972.

Perrow, C., Organizational Analysis: A Sociological View, Brooks/Cole, Belmont, CA, 1970.

Phillips, A., "Word-Processing and Text-Handling Devices," J. of Research Communication Studies, Vol. 1, No. 1, 1978, pp. 3-18.

Polzak, L. A., Jr., "Word Processing," Armed Forces Comptroller, Vol. 25, No. 2, May 1980, pp. 26-29.

Poppel, H. L., "Planning for the Electronic Office of the Future," Management Review, Vol. 67, No. 6, June 1978, pp. 39-40.

Porat, M. V., The Information Economy (Vol. 1), Unpublished doctoral dissertation, Stanford University, Stanford, CA, 1976.

Pressman, J. L., and A. Wildavsky, Implementation, University of California Press, Berkeley, CA, 1973.

Primrose, Bette, "The Operating Manual--A WP Essential," Modern Office Procedures, Vol. 23, No. 7, July 1978, p. 78.

Pugh, D. S., D. J. Hickson, C. R. Hinings, and C. Turner, "Dimensions of Organizational Structure," Administrative Science Quarterly, Vol. 13, 1968, pp. 65-105.

Radnor, M., D. Hofler, and P. Rich (eds.), Information Dissemination and Exchange for Educational Innovations, Part One, Northwestern University Center for the Interdisciplinary Study of Science and Technology, Evanston, IL, 1977.

Rice, R. E., and E. M. Rogers, "Reinvention in the Innovation Process," Knowledge: Creation, Diffusion, Utilization, Vol. 1, No. 4, 1980, pp. 499-514.

Robey, D., "Computers and Management Structure: Some Empirical Findings," in D. Katz, R. L. Kahn, and J. S. Adams (eds.), The Study of Organizations, Jossey-Bass, San Francisco, CA, 1980.

Rogers, E. M. Diffusion of Innovations, Free Press, New York, NY, 1962.

_____, "Communication of Vocational Rehabilitation Innovations," Communication, Dissemination, and Utilization of Rehabilitation Research Information, Joint Liaison Committee of the Council of State Administrators of Vocational Rehabilitation and the Rehabilitation Counselor Educators, Studies in Rehabilitation Counselor Training No. 5, Department of Health, Education and Welfare, Washington, DC, 1967.

Rogers, E. M., and L. Svenning, Managing Change, Operation PEP, Department of Health, Education and Welfare, Washington, DC, 1969.

Rogers, E. M., and F. F. Shoemaker, Communication of Innovations: A Cross-Cultural Approach, Free Press, New York, NY, 1971.

Rousseau, D. M., "Technology in Organizations: A Constructive Review and Analytic Framework," in S. E. Seashore and P. H. Mirvis (eds.), Assessment of Organizations, Wiley Interscience, New York, NY, 1980.

Sadler, C. D., "Office of the Future--New Challenges for Operational-Research," Omega-International J. of Management Science, Vol. 8, No. 1, 1980, pp. 21-28.

Sapia, Suzanne, "Agency Automation," Insurance Marketing, Vol. 79, No. 9, Sept. 1978, pp. 58-65, 96-104.

Sathe, V., "Institutional Versus Questionnaire Measures of Organizational Structure," Academy of Management J., Vol. 21, 1978, pp. 227-238.

Schon, D. A., Technology and Change: The Impact of Invention and Innovation on American Social and Economic Development, Dell, New York, NY, 1967.

Shantz, C. E., "What's That Word Processing Station Really Doing," Administrative Management, Vol. 37, No. 3, Mar. 1976, pp. 51-54.

Shavelson, R. J., and N. M. Webb, "Generalizability Theory: 1973-1980," British Journal of Mathematical and Statistical Psychology, in press.

Shiff, Robert, "We Need No Secretaries," The Office, Vol. 79, No. 2, Feb. 1974, pp. 18-20.

Smith, A. E., "Word Processing Pilot Project," Management Services in Government, Vol. 34, No. 2, 1979, pp. 86-89.

Smith, Janine E., "Choosing a New Generation Word-Processing System," Office, Vol. 92, No. 5, Nov. 1980, pp. 133-138.

Smith, M. C., and L. E. Magee, "Tracing the Time Course of Picture-Word Processing," J. of Experimental Psychology-General, Vol. 109, No. 4, 1980, pp. 373-392.

Smith, P. K., The Job Diagnostic Index (JDI), Unpublished, circa 1965.

Spak, G. T., and E. F. Shelley, How to Operate an Energy Advisory Service, Vol. I: Report and Recommendations, Final Report to the Department of Education, New York Institute of Technology, Old Westbury, NY, 1978.

Sterling, T. D., "Consumer Difficulties with Computerized Transactions: An Empirical Investigation," in R. Kling (ed.), Communications of the ACM, Vol. 22, No. 5, May 1979.

Stevens, W. F., and L. G. Tornatzky, "The Dissemination of Evaluation: An Experiment," Evaluation Review, Vol. 4, No. 3, 1980, pp. 339-354.

Stoneman, P., Technological Diffusion and The Computer Revolution: The UK Experience, Cambridge University Press, New York, 1976.

Strassman, Paul A., "The Office of the Future: Infoımation Management for the New Age," Technology Review, Vol. 82, No. 3, Dec. 1979/Jan. 1980, pp. 54-65.

Taylor, J. C., "Experiments in Work System Design: Economic and Human Results," Personnel Review, Vol. 6, No. 3, 1977, pp. 21-34.

_____, Fragmented Office Jobs and the Computer, Center for the Quality of Working Life, U.C.L.A., Los Angeles, CA, Sept. 1978.

_____, "Word Processing and Quality of Life in the Office," Words, Mar. 1980.

Thoryn, M., "Office Equipment: Electronics Empties the Typing Pool," Nation's Business, Vol. 67, No. 2, Feb. 1979, pp. 70-78.

_____, "Tomorrow's Office: Wired for Words," Nation's Business, Vol. 68, No. 7, July 1980, pp. 56-64.

Tornatzky, L. G., E. O. Fergus, J. W. Avellar, G. W. Fairweather, with M. Fleischer, Innovation and Social Process, Pergamon Press, New York, 1980.

Trist, E. L., G. W. Higgin, H. Murray, and A. B. Pollock, Organizational Choice, Tavistock, London, England, 1963.

Umberger, D. W., Jr., "Implementing Word Processing Stations that are Miles Apart," Office, Vol. 92, No. 4, Oct. 1980, pp. 91-93.

von Hippel, Eric, "The Dominant Role of Users in the Scientific Instrument Innovation Process," Research Policy, Vol. 5, No. 3, 1976, pp. 212-239.

Wagner, Barbara, "Meeting the Challenge in a Word-Processing Center," Office, Vol. 92, No. 5, Nov. 1980, pp. 98-100.

Walshe, W. A., "Math-Sort Packages--New Dimensions in Word Processing," American Bar Association J., Vol. 65, Jan. 1979, p. 72.

Walshe, Willoughby Ann, "Computerized Word-Processing Combines with Data Processing," Word Processing Systems, Vol. 7, No. 11, Nov. 1980, pp. 12-14.

Weiler, D., The Dissemination of Educational Research and Development Products: Research and Policy Issues for the Federal Government, The Rand Corporation, P-4984, 1973.

White, R. S., "A Prototype for the Automated Office," Datamation, April 1977.

Whitehead, J. B., "Developments in Word Processing Systems and Their Application to Information Needs," Aslib Proceedings, No. 3, 1980, pp. 118-133.

Whitney, M. G., "Security Pacific Bank Looks at the Office of the Future," Industrial Engineering, Vol. 12, No. 7, July 1980, pp. 38-39.

Winkler, Connie, "Office of Future May Not Work, Poppel Warns," Computerworld, Vol. 13, No. 21, May 21, 1979, p. 12.

Winograd, Terry, "Beyond Programming Languages," Communications of the ACM, Vol. 22, No. 7, July 1979.

Woodward, J., Industrial Organization: Theory and Practice, Oxford University Press, London, England, 1965.

Working Women, Race Against Time: Automation of the Office, National Association of Office Workers, Cleveland, April, 1980.

Workshop on Evaluating for Impact of Office Automation, Xerox Palo Alto Research Center, May 13-14, 1976.

Yin, R. K., Changing Urban Bureaucracies: How New Practices Become Routinized, The Rand Corporation, Santa Monica, CA, R-2277-NSF (Final Report to NSF), 1978.

Yin, R. K., K. A. Heald, M. E. Vogel, P. D. Fleischauer, and B. C. Vladeck, A Review of Case Studies of Technological Innovations in State and Local Services, The Rand Corporation, Santa Monica, CA, R-1870-NSF (a Final Report to the National Science Foundation), 1976.

Yin, R. K., S. Quick, R. Bateman, and E. Marks, Changing Urban Bureaucracies: How New Practices Become Routinized--Appendixes, The Rand Corporation, Santa Monica, CA, R-2277/1-NSF (Final Report to the National Science Foundation), 1978.

Young, R. T., "Forecasting, Monitoring and Controlling Productivity, Industrial Engineering, Vol, 12, No. 7, July 1980, pp. 46-49.

Zisman, M. D., "Office Automation," Computer Decisions, March 1981, pp. 54-56.